SECTION 26 09 13

POWER MONITORING AND CONTROL SYSTEM

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI INCITS 154	(1988; R 2004) Office Machines and Supplies - Alphanumeric Machines-Keyboard Arrangement

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C37.90.1	(2002) Surge Withstand Capability (SWC) Tests for Relays and Relay Systems Associated with Electric Power Apparatus
IEEE C57.13	(1993; R 2003) Standard Requirements for Instrument Transformers
IEEE C62.41.1	(2002) IEEE Guide on the Surges Environment in Low-Voltage (1000 V and Less) AC Power Circuits
IEEE C62.41.2	(2002) IEEE Recommended Practice on Characterization of Surges in Low-Voltage (1000 V and Less) AC Power Circuits
IEEE Std 802.3	WARNING: Text in tags exceeds the maximum length of 300 characters

INTERNATIONAL ELECTROTECHNICAL COMMISSION (IEC)

IEC 61000-4-5	(2005) Electromagnetic Compatibility (EMC) - Part 4-5: Testing and Measurement Techniques; Surge Immunity Test

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA 250	(2003) Enclosures for Electrical Equipment (1000 Volts Maximum)

NEMA C12.1	(2001) Electric Meters; Code for Electricity Metering
NEMA C12.20	(2002) Electricity Meter - 0.2 and 0.5 Accuracy Classes
NEMA ICS 1	(2000; R 2005) Standard for Industrial Control and Systems General Requirements
NEMA WC 74	(2006) Standard for 5-46 kV Shielded Power Cable for use in the Transmission and Distribution of Electric Energy

TELECOMMUNICATIONS INDUSTRY ASSOCIATION (TIA)

TIA-232-F	(1997; R 2002) Interface Between Data Terminal Equipment and Data Circuit-Terminating Equipment Employing Serial Binary Data Interchange
TIA-485-A	(1998; R 2003) Electrical Characteristics of Generators and Receivers for Use in Balanced Digital Multipoint System
TIA/EIA-568-B.1	(2001 Addendums 2001, 2003, 2003, 2003, 2004, 2007) Commercial Building Telecommunications Cabling Standard - Part 1: General Requirements

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

47 CFR 15	Radio Frequency Devices

1.2 RELATED REQUIREMENTS

a. All of the Contract Documents, including General and Supplementary Conditions and Division 1 General Requirements, apply to the work of this section.

b. Other Specification Sections that directly relate to the work of this section include, but are not limited to, the following:

1. Section 26 00 00.00 20 BASIC ELECTRICAL MATERIALS AND METHODS
2. Section 26 05 73 OVERCURRENT POTECTIVE DEVICE COORDINATION STUDY
3. Section 26 08 00 APPARATUS INSPECTION AND TESTING
4. Section 26 11 16 SECONDARY UNIT SUBSTATIONS
5. Section 26 23 00 SWITCHBOARDS AND SWITCHGEAR
6. Section 27 21 10.00 10 FIBER OPTIC DATA TRANSMISSION SYSTEMS
7. Section 33 75 00.00 40 HIGH VOLTAGE SWITCHGEAR

1.3 SYSTEM DESCRIPTION

1.3.1 System Requirements

This section includes the supply and installation of a complete Power Management and Control System (PMCS) as detailed in the drawings and as described in this specification.

The contractor shall furnish and install the equipment specified herein. The equipment shall be as shown in the drawings and outlined below.

1.3.2 System Description Overview

a. The Power Management and Control System (PMCS) shall be a Web Based Monitoring & Control system that monitors and controls all specified locations in the distribution system without any further configuration or setup required after complete installation by the contractor. The PMCS is defined to include, but not to be limited to, remote devices for monitoring, control and protection, device communication interface hardware, intercommunication wiring, monitoring stations, software, software configuration, ancillary equipment, startup and training services.

   1. The substation automation system shall have communication interfaces to supervisory, control and data acquisition (SCADA) systems. It shall selectively identify and isolate faults. It shall transmit, record and evaluate data.

   2. The substation automation system shall gather the data of the substation, plant or field (commands, events, counters and measured values), to process this raw data and to forward the resulting information. The data of the substation shall be gathered by the decentralized substation automation system via connected IEDs and the relevant transmission protocols. It shall be configured to pass relevant information to the applicable observation, monitoring or control centers.

   3. The substation automation system shall execute the automation tasks of logical operations and switching sequences. A local human machine interface (HMI) shall be necessary to perform control and monitoring tasks.

b. The PMCS software shall be designed specifically for Power Monitoring & Control.

c. The following diagnostics tools shall be supplied in the equipment lineup.

   1. Standard sequence of event recording shall be provided. This feature will enable the user to view via the equipment HMI, any trip, alarm, logged event, etc. The system will have

unified time synchronization so that all recorded occurrences will be time stamped.

2. Diagnostic tools shall be supplemented by the waveform capture enhancement. This feature will enable the user to view, via the equipment HMI, waveforms that are triggered from a trip, an alarm or a manual initiation. The specifics of the waveform capture are detailed below:

    a) Current waveforms for phase A, phase B, phase C and neutral when the lineup is connected to a WYE power source.

    b) Voltage waveforms for phases A-B, phases B-C, phases C-A and when the lineup is connected to a WYE power source, the additional voltage waveforms shall be provided – phase A-N, phase B-N, phase C-N.

3. Redundant PLCs. All control to be performed by PLC with hot standby redundant PLC.

4. Full sequence of events and wave-form capture for all breakers in the lineup.

5. The system shall include a user interface which provides a Graphical User Interface which shall allow for graphical navigation between systems, graphical representations of systems, access to real-time data for systems, ability to override points in a system, access to all supervisory monitoring and control functions. The GUI shall be a touch screen, minimal 19", with a keyboard.

6. The PMCS shall include an IP network and shall interface to all workstations and PMCS PLCs. The network shall interface with the new and existing legacy supervisory control and data acquisition system (SCADA) at the Main Substation and include capabilities for expansion to control and monitoring site wide. The existing SCADA platform is Substation Explorer and SubstationServer.Net by Subnet Solutions and installed by Orion Technical Services, Mohnton, PA. See exhibits 1 and 2.

7. The system shall perform SCADA functions including but not limited to Scheduling, Alarm Handling, Trending, Report Generation and Electrical Peak Demand Limiting as specified.

d. Operator workstations will be provided to show SCADA information. Users and passwords will be used to allow control of the system.

e. Engineering workstation will be provided to give access to all PQM data, protection relay data, and PLC functions. Users and passwords will be used to allow control of the system.

f. Alarms and events shall be capable of having programmed time delays and high-low limits.

Introduction

This document has been prepared to serve as an Operations and Maintenance Manual for the relay and SCADA equipment installed as part of the FAA William J. Hughes Technical Center Main Substation Upgrade Project performed in October 2008. Included in the manual information on the SCADA system architecture and operation and information on the protective relaying systems installed to protect the airport's electrical grid emanating from the Main Substation.

SCADA System

The Supervisory Control and Data Acquisition (SCADA) system installed for the project has been designed based on an integrated approach leveraging information available in the microprocessor based protective relays installed as part of the project. This approach reduces the amount of redundant equipment required for both the SCADA and protective relaying systems and offers a wealth of information useful for the operation and maintenance of the substation and associated electrical system.

System Overview

An overview of the SCADA system architecture is provided in Figure 1-1:

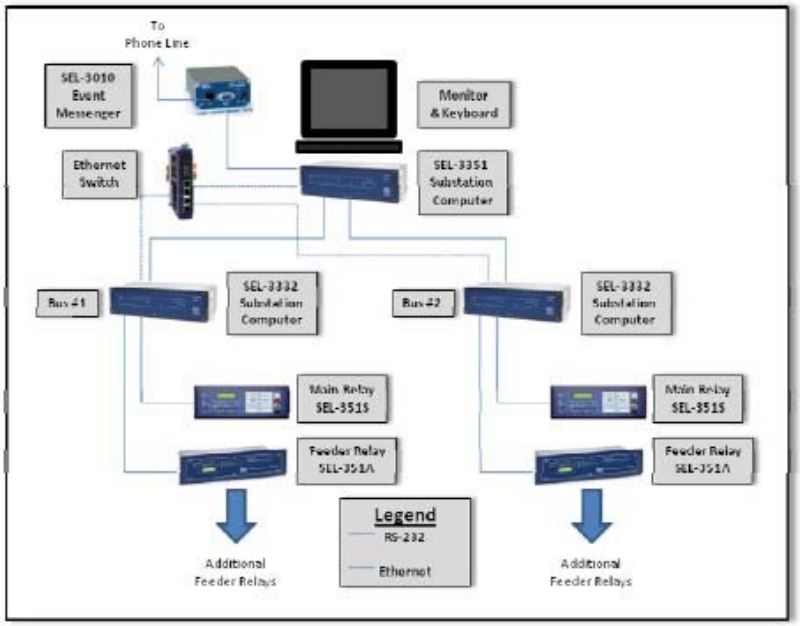

Figure 1-1 - System Overview

The components and their respective functions are described in Table 1-1.

Exhibit 1

Orion Technical Services, LLC

Table 1-1 – System Overview Functional Description

Component	Function
SEL-351A Feeder Relay	Provides phase and ground overcurrent protection, breaker control, and alarm processing for the distribution feeders.
SEL-351S Main Relay	Provides phase and ground overcurrent protection, main-tie-main scheme control, breaker control, and alarm processing for the main circuit breakers. The 52-1 relay also controls the tie circuit breaker.
SEL-3332 Intelligent Server	One unit installed per switchgear bus to provide physical interconnection (RS-232) to relays, concentrate data retrieved from relays to be retrieved by SEL-3351. Also provides port server connection to relays to allow for direct communication with relays and event record retrieval.
SEL-3351 Substation Computer	Retrieves metering and alarm data from SEL-3332 computers, creates alarm messages for SEL-3010 Event Messenger, and serves data to the display software package. Also checks for new relay events and automatically retrieves them for analysis.
SEL-3310 Event Messenger	Receives automatically generated event messages from the SEL-3351 Substation Computer and notifies up to four (4) phone numbers of the alarm. Alarm messages are generated using a voice synthesizer to provide a spoken message.
Ethernet Switch	Provides a local Ethernet network to interconnect the substation computers. This interconnection is used primarily for the Port Server module to allow direct ASCII communication with the relays using a serial over IP method.
Monitor & Keyboard	Used for system displays and system control. Keyboard is mounted in a slide-out tray.

Interface and Protocol Overview

Various hardware interfaces and communications protocols are used throughout the system. These protocols are discussed in further detail throughout this manual, however, an overview of the protocols is provided below in Table 1-2.

Table 1-2 – Protocol Overview

Connection	Interface	Protocol
Relays – SEL-3332	RS-232	SEL Fast Messaging – SCADA, SEL-ASCII for Engineering Access via Port Server
SEL-3332 – SEL-3351 (SCADA)	RS-232	Serial DNP 3.0
SEL-3332 – SEL-3351 (Engr)	Ethernet	SEL-ASCII over IP via the Port Server module
SEL-3351 (HMI)	Ethernet	Localhost connection between SubstationServer.Net and Substation Explorer software packages.
SEL-3351 – SEL-3010	RS-232	SEL-ASCII messaging

Device Descriptions

This section contains information on each of the major SCADA components. Descriptions of the protective relays are included in another section.

1.3.3 System Response Times

a. Any new display shall begin to update the workstation monitor within 2 seconds after being requested. Preformatted displays shall be completely presented within 5 seconds after the request.

b. All calculated values shall be updated from the database, when displayed at the workstation, at least every 15 seconds.

c. Digital status indications, when displayed at the workstation, shall be updated within 15 seconds from the IED.

d. Analog values, when displayed at the workstation shall be updated within 15 seconds from the IED.

1.3.4 System Accuracy and Display

The system shall maintain the specified end-to-end accuracy from sensor to all workstation displays, including the effects of transmitters, transducers, and engineering units conversions, for one year for the applications specified and shall report and display changes in sensed values as specified. The system accuracy and display requirements are as follows:

a. Current: with a range for the specific application ± 1.0% of reading; display and print to nearest ampere.

b. Voltage: with a range for the specific application ± 1.0% of reading; display and print to nearest volt.

c. Power Factor: 1.0% of reading; display and print to nearest hundredth.

d. kWh: with a range for the specific application ± 1.0% of reading; display and print to nearest kWh.

e. KW: with a range for the specific application ± 1.0% of readings.

f. KVA: with a range for the specific application ± 1.0% of reading; display and print to nearest KVA.

g. KVAR: with a range for the specific application ± 1.0% of reading; display and print to nearest KVAR.

h. Frequency: ± 0.05 Hz; display and print to nearest 0.1 Hz.

i. Total Harmonic Distortion (THD) in percent for current and voltage, each phase.

j. K-Factor (dimensionless ratio based on harmonic content of current waveform).

k. Special application(s) added by the designer, as needed.

1.3.5 Environmental Requirements

a. Workstation in Building 304 and associated equipment shall operate without damage or degradation under the following ambient conditions, unless otherwise noted.

1. Operating Temperature: 60 to 85 degrees F.

2. Operating Humidity: 20 to 80 %, non-condensing.

b. All field equipment shall operate without damage or degradation under the following ambient conditions, unless otherwise noted.

1. Operating Temperature: 32 to 122 degrees F.

2. Operating Humidity: 10 to 90 %, non-condensing.

1.3.6 Electrical Transients and Electromagnetic Interference

1.3.6.1 Power Line Surge Protection

Workstation equipment connected to ac circuits shall be protected from power line surges and meet the requirements of IEEE C62.41.1 and IEEE C62.41.2 location category A3, while equipment is operating. In addition, all IEDs shall be protected to meet the requirements of IEEE C37.90.1 or the requirements of IEC 61000-4-5, test level 4, while the equipment is operating. Fuses shall not be used for surge protection.

1.3.6.2 Sensor Wiring Surge Protection

All digital and analog inputs of all IEDs shall be protected against surges induced on sensor wiring to meet the requirements of IEEE C37.90.1 or the requirements of IEC 61000-4-5, test level 4, while the equipment is operating. Fuses shall not be used for surge protection.

1.3.6.3 Communications Channels Surge Protection

Communications equipment shall be protected against surges induced on its communications channels. Communication interfaces to all field equipment shall be protected to meet the

requirements of IEEE C37.90.1 or the requirements of IEC 61000-4-5, test level 4, while the equipment is operating. Fuses shall not be used for surge protection. Metallic cables and conductors which serve as communications channels between buildings shall have surge protection installed at equipment and additional triple electrode gas surge protectors rated for the application installed at each end, within three feet of the building cable entrance. Surge protectors shall meet the requirements of NEMA C62.61.

1.3.7 Workstation Equipment Power Source

Workstation equipment shall be powered from a 1500 VA uninterruptible power supply (UPS) fed from local emergency panel or inverter as shown.

1.3.8 Communications Overview

a. The PMCS system shall be able to utilize the following standard communications configurations, as a minimum, at the same time:

1. Direct RS485 serial communications for cable runs of less than 4000ft. Longer RS-485 runs can be achieved with the use of a RS485 repeater. RS485 supports communication with up to 32 devices per communications string. Each string shall consist of good quality 24 AWG (or greater) twisted pair shielded cable for RS485 communications.

2. Standard Ethernet TCP/IP, 802.3 communications networks. Ethernet communications of either CAT-5 or Fiber Optic shall be supported at a 10BaseT communications speed.

3. The PMSC system shall be able to utilize the facilities Intranet network and Internet WAN communications networks.

b. Individual equipment line-ups shall be fully wired and tested by the manufacturer such that the contractor need only provide one connection for communication.

1.4 SYSTEM INTEGRATION

1.4.1 Experience

Vendors need to demonstrate previous experience with projects with similar complexity and have at least 10 years experience with systems integration. Proof of capability and successful projects is required. The Government will determine if the integration vendor has adequately proven their capabilities for this project.

1.4.2 Software

All software supplied will be open architecture, commercially available off the shelf.

a. Vendors will need to provide several screen shots of HMI as examples.

1.4.2.1 Software Documentation

Software documentation shall include the following sections:

a. Cover page, table of contents.

b. Process signal lists (configuration lists).

c. Interlocks, automation functions.

The following shall be included:

a. Creation of the documentation with a program that conforms to the procedure.

b. Delivery of the documentation in letter paper format and as a data file on CD-ROM.

1.4.2.2 Process Signal Lists

Process signal/configuration lists shall record all signals that are to be processed by the software. Assignment are unit- or bay-orientated and allocates a specific I/O to a specific signal. A table simultaneously defining which information points are to be routed where:

a. Telecontrol-addresses.

b. Event/Alarm list.

c. HMI

1.4.2.3 Automatic Functions

a. Interlocking and automation functions have to be documented using a graphic configuration tool that conforms to IEC 1131 regulations.

1.4.3 CRITICAL SYSTEMS INTERGRATOR

1.4.3.1 Experience

The Vendor of the above referenced equipment package shall hereby be designated the Critical Systems Integrator, hereinafter referred to as the CSI. The CSI shall provide all major services required to insure complete coordination between major component vendors, electrical contractors,

engineer and owner. The CSI shall be a manufacturer's representative and/or distributor for at least one of the major components specified and have at least 10 successfully completed local projects proving CSI completed services as described in this specification.

1.4.3.2 Services

a. The CSI shall insure that each individual manufacturer provides a compatible interface to the existing critical monitoring system. This interface shall be factory installed by each manufacturer. Custom graphics, reports and alarms shall be provided as required to insure full integration into this monitoring system.

b. The CSI shall provide a single customized submittal package covering all of the equipment listed. After submittal and preparation of interconnect wiring diagrams (Item c below) the CSI shall provide final as-built equipment drawings and interconnect wiring diagrams to the Government, in a single three ring binder. Six hardcopies and CDs with drawings in AutoCad and documents in Adobe formats.

c. The CSI shall be responsible for preparing custom interconnect wiring diagrams detailing terminal block control interconnects between all equipment. The CSI shall meet with the electrical contractor prior to installation of the equipment to review all necessary connections. The CSI shall supervise these connections by the electrical contractor on an as needed basis. Further, the CSI shall inspect and verify these connections prior to start-up of the individual pieces of equipment. Finally the CSI shall provide complete system as-built and as-installed diagrams to the Government.

d. The CSI shall be responsible for reviewing all interconnect wiring with respect to properly oversizing and shielding interconnect control and synchronizing wiring where long runs are involved. The CSI will be responsible for proper operation of these systems. In addition, the CSI shall insure that where necessary interconnect wiring is installed in separate conduits.

e. To insure the project schedule, the CSI shall be able to provide a two hour maximum on-site response time to a question posed by the Government engineer or contractors. The CSI shall provide in his proposal a local Project Management team diagram. This diagram shall provide the owner with a quick reference document of all responsible parties, key personnel, management names including their titles, phone and pager numbers. The management team shall list back-up individuals for each piece of equipment if the primary project manager is not available.

f. The CSI will provide the Government on predetermined intervals, (i.e. weekly) written, current updates of production and shipment schedules of all critical equipment. Special expediting action will be taken as required.

g. The CSI shall be responsible for the costs of travel for the installation team and for coordinating

and scheduling all factory witness testing. The CSI will obtain the factory test procedure 30 calendar days prior to the scheduled test and forward it to the Government for review and approval. Any required corrections or changes will be coordinated through the CSI. All substations and medium voltage gear shall be tested together at one location within 100 miles of the project site.

h. The CSI shall provide personnel to supervise on-site start-up procedures and conduct testing of each individual major component. The CSI shall insure that documentation of all start-up tests is properly completed so as to provide a base line benchmark for individual equipment performance.

i. Provide Pre-Commissioning services by reviewing the individual equipment shop drawings for proper coordination, equipment features, controls and accessories to ensure that the equipment can function per the desired sequence of operations and at the designed loads. Note any deficiencies.

    1. Write individual Start-up checklists to be completed by the individual manufacturer field technicians during their start up procedures. These start up checklists compliment the manufacturer's generic start up procedure but are site specific in that they parallel the requirements of the equipment specifications and the integrated equipment & system testing.

    2. Prepare a list of required information for the circuit breaker short circuit & coordination study to be completed by the installing electrical contractor.

    3. Write the actual test procedures for approval.

    4. Assist with the short circuit coordination study.

j. Provide On-Site individual equipment performance testing (after start-up).

    1. Review and verify all manufacture specific and site specific start up reports are available and complete.

    2. Test for proper operation of switchgear meters, controls and annunciation.

    3. Test for proper Switchgear Sequence of Operations.

    4. Perform circuit breaker primary injection testing and contact resistance testing. Breaker testing must be performed by a NETA certified testing agent.

    5. Perform SCADA System verification & testing.

6. Perform infrared thermoscan of all defined equipment, devices and connections.

k. Provide Project Documentation and close-out.

1. Prepare Testing Documentation manual(s) to include:

a) Overall summary of results, deficiencies noted (if any), recommendations (if any) and conclusions.

b) Actual results of system wide testing.

c) Actual results of all load, transfer, transient and power quality monitoring.

d) Copies of all completed individual test reports, site-specific start up checklists and manufacturer start up reports.

1.5 DELIVERY OF TECHNICAL DATA AND COMPUTER SOFTWARE

1.5.1 Data, Drawings, CD-ROMs, and Manuals

All items of software and technical data (including technical data which relates to computer software), which is specifically identified in this specification shall be delivered strictly in accordance with the CONTRACT CLAUSES. All data delivered shall be identified by reference to the particular specification paragraph against which it is furnished. All drawings submitted shall be in DWG file structure. Five sets of CD-ROMs shall be provided after final drawings are approved. Manuals provided shall contain the minimum content specified, although varied packaging and formats are acceptable. The Contractor may submit standard manuals with additions as necessary to conform to the requirements listed below.

1.5.2 Technical Data Package 1 - Existing Conditions Report

The data package shall include the existing conditions report as specified in Paragraph: Existing Conditions Survey, and associated documentation as specified.

1.5.3 Technical Data Package 2 - System Data

1.5.3.1 System and Installation Drawings

a. Power monitoring system block diagram.

b. Layout plans showing equipment locations and cable routing.

c. Field equipment installation drawings including dimensional drawings of any existing

enclosures showing equipment cutouts and mounting locations, and indicating adequate clearance from existing wiring and devices per manufacturer's recommendations.

d. Instrument transformer wiring and installation drawings.

1.5.3.2 Equipment Data

Hardware documentation shall include a circuit manual, central cabinet/field cabinets and device documentation. The device documentation shall be stated in the device manual and has to include the following:

a. Information on the internal structure and functions (block diagrams) of the device.

b. Technical data of the devices and their parts, order details, maintenance instructions.

c. Description of the functional scope.

d. Representation of all interfaces.

e. Instructions for commissioning (device-specific setting values) and fault diagnosis.

f. Supply of the device documentation per device type.

The cabinet documentation is to be stated in the circuit manual, to be generated with a CAD system or other software tools and to be supplied in paper form (DIN A4) and on a data carrier. The circuit manual has to include the following sections:

a. Covering page, table of contents of drawings.

b. Location diagram (cubicle layout).

c. Circuit diagram for central, higher-level functions.

d. Circuit diagram per bay/cubicle, divided according to functions.

e. Equipment plan.

f. Terminal diagram (external interface connection).

g. Assignment of the interface elements (terminal diagram).

h. Lists of components.

The circuit diagrams shall include the current paths in a functional-related assignment of the units. Units should be displayed in a detached representation with their connections. The unit's inner circuit paths shall not be displayed. Labeling of the units shall be done in accordance with the plant identification system DIN40719, Part 2. The marking of the break off points and references shall be done in accordance with DIN40719, Part 3. For evaluation purposes, connection points shall only be represented once in the wiring manual.

Terminal diagrams shall include the construction of the terminal strip with the used terminal types, terminal accessories, cable types and destination references to connected devices.

The cabinet views shall display the position of the installed units from the front and the backside. A cross section from the side and the top shall also be provided.

The equipment diagrams shall display the external connection points of the unit. An equipment diagram should exist for every installed unit. It suffices to display the schematic internal construction of the unit.

Component lists shall include the technical data, ordering data, equipment names, the place of installation and the amount of units in use inside a cabinet. Component lists should be delivered as an MS-Excel file and included in the cabinet documentation.

1.5.3.3 Installation, Setup and Operation Guides

The data package shall include the manufacturer's standard installation, setup and operation guides for workstation equipment and field equipment, and shall include details of the published open protocol for communications.

1.5.3.4 User's Guides

The data package shall include the manufacturer's standard user's guides for all software provided with the system.

1.5.3.5 Certifications

The Contractor shall provide written certifications that system components meet the requirements specified including:

a. 47 CFR 15
b. IEEE C62.41.1 and IEEE C62.41.2
c. NEMA C12.1
d. NEMA C62.61
e. IEEE C37.90.1 or IEC 61000-4-5.

1.5.4 Technical Data Package 3 - Training Data

Lesson plans and training manuals for the training phases, including type of training to be provided and with a list of reference material shall be submitted for approval as specified.

1.5.5 Technical Data Package 4 - Performance Verification Testing Procedures

The Contractor shall submit test procedures for the Performance Verification Test (PVT). The test procedures shall explain in detail, step-by-step actions and expected results to demonstrate compliance with the requirements of this specification. The Contractor shall submit the PVT procedures for approval.

1.5.6 Technical Data Package 5 - Performance Verification Testing Data

The Contractor shall submit the performance verification test data to the Government after the Government approves the performance verification test.

1.5.7 Technical Data Package 6 - Operation and Maintenance Manuals

The operation and maintenance manuals shall consist of a resubmission of all technical data identified as Technical Data Package 2, bound in three-ring binder, with as-built corrections and revisions and with addenda/appendices as necessary to identify any special characteristics or operations not covered in the manufacturer's standard documentation. The Contractor shall submit 6 copies of the operation and maintenance manuals within 30 days following successful completion of the PVT.

1.6 SUBMITTALS

a. The following information shall be submitted to the Engineer and Owner prior to design or installation.

SD-03 Product Data, G

System description including an overview of the system provided with detailed description of suggested communication architecture and the screens to be provided.

Bill of Material including a complete listing of all hardware, software, configuration, training and start-up services being supplied under this contract.

Hardware and software description shall be provided in detail for all communications hardware, software, including sensor devices gathering data to be transmitted over the network and the Power Management Engineering Station.

SD-10 Operation and Maintenance Data, G

Six copies of operation and maintenance manuals, within 14 calendar days following the completion of tests and including assembly, installation, operation and maintenance instructions, spare parts data which provides supplier name, current cost, catalog order number, and a recommended list of spare parts to be stocked. Manuals shall also include data outlining detailed procedures for system startup and operation, and a troubleshooting guide which lists possible operational problems and corrective action to be taken. A brief description of all equipment, basic operating features, and routine maintenance requirements shall also be included. Documents shall be bound in a binder marked or identified on the spine and front cover. A table of contents page shall be included and marked with pertinent contract information and contents of the manual. Tabs shall be provided to separate different types of documents, such as catalog ordering information, drawings, instructions, and spare-parts data. Index sheets shall be provided for each section of the manual when warranted by the quantity of documents included under separate tabs or dividers.

Electronic Format of operation and maintenance data to be delivered as a complete project package including PMCS, HVAC, and other equipment within 30 days following the approval of the manuals.

SD-11 Closeout Submittals, G

Assembled Operation and Maintenance Manuals, Hardcopy and Electronic Versions. Equipment test schedule.

1.7 TESTING

1.7.1 General Requirements for Testing

The testing shall consist of Factory Acceptance Testing (FAT), Site Acceptance Testing (SAT), and a Performance Validation Test (PVT). The PVT shall be performed on a complete and working system to validate interdependent functionality and control. The Contractor shall perform testing in conjunction with the Manufacturer and the Critical Systems Integrator (CSI). The Contractor shall provide all personnel, test equipment, instrumentation, and supplies necessary to perform all testing. Written notification shall be given to the Government at least 21 days prior to any testing, and in no case shall notice be given until after the Contractor has received written Government approval of the specific testing procedures.

1.7.2 Test Procedures and Reports

The procedures shall consist of detailed instructions for test setup, execution, and evaluation of test

results. The test reports shall be used to document results of the tests. Reports shall be delivered to the Government within 7 days after completion of test.

1.8 MAINTENANCE AND SERVICE

1.8.1 General Requirements

The Contractor shall provide all maintenance services required and equipment necessary to maintain the entire system operational, as specified, for a period of 5 years after system acceptance. Maintenance shall include preventive maintenance in addition to repairs, replacements, and adjustments and software updates. Written permission shall be obtained from the Government prior to performing any service work or adjustments which have any impact on facility operations.

1.8.2 Description of Work

The adjustment and repair of the system includes all workstation equipment and field equipment including software updates. Contractor shall perform each manufacturer's required adjustments and all other work necessary for proper operation as specified.

1.8.3 Service Calls

The Government will initiate service calls when the system is not functioning properly. The Government shall be furnished with a telephone number where the service supervisor can be reached at all times. Service personnel shall be at the site within three working days after receiving a request for service. The system shall be restored to proper operating condition within seven working days after receiving a request for service.

1.8.4 Records and Logs

The Contractor shall keep records and logs of each maintenance and service task, and shall organize cumulative records for each major component, and for the complete system chronologically. A continuous log shall be maintained for all devices on a site-by-site basis. The log shall contain all initial analog span and zero calibration values and testing of all digital points. Complete logs shall be kept and shall be available for inspection onsite, demonstrating that planned and systematic adjustments and repairs have been accomplished for the system. The Contractor shall provide the Government with a summary report of the maintenance and service performed during each previous month.

1.8.5 System Modifications

The Contractor shall make any recommendations for system modification as part of maintenance and service in writing to the Government. No system modifications, including operating parameters and control settings, shall be made without prior approval of the Government. Any modifications made to

the system shall be incorporated into the system documentation including drawings and manuals.

1.8.6 Software

The Contractor shall provide notices of all software updates and verify operation in the system, if the Government chooses to incorporate the update. These updates shall be accomplished in a timely manner, fully coordinated with system operators, and shall be incorporated into the manuals and software documentation. The Contractor shall install and validate the latest released version of the software, upon receiving written approval by the Government.

1.8.7 Telephone Consultation

The Contractor shall provide up to 40 hours per year of telephone consultation to Government personnel. The Contractor shall keep a log by month, identifying caller, date and length of call, and results of call.

PART 2 PRODUCTS

2.1 MATERIALS AND EQUIPMENT

2.1.1 Manufacturers

Units of the same type of equipment shall be products of a single manufacturer. The power monitoring and control system shall be supplied by Siemens or pre-approved equal.

2.1.2 PMCS Server & Client Requirements

The PMCS Server computer shall include 2 factory supplied server computers with at least the following features:

a. Minimum Intel Xeon computer with 4 GB RDIMM, 2.4 GHz,2- 500 GB hard disk drive on SCSI RAID-1, 3 ½" diskette drive, 24 x speed CD read/write drive, 19" XGA monitor, XGA video card, full-size 101-key enhanced keyboard and a mouse.

b. Windows 2003 Server.

c. Optional software as required for system configuration and data logging, as needed.

d. A minimum of one (1) parallel port and two (2) serial ports.

e. Auto-reboot capability upon return from power failure. Necessary programs must then automatically launch without user intervention.

f. 100% IBM compatible.

g. All in One color printer, with 2 spare cartridges for each style required.

The PMCS project shall include 6 Web Based Client computers with the following features:

a. Minimum Intel Core 2 Duo computer with 4 GB SDRAM, 550Mhz, 5 GB hard disk drive, 3 ½" diskette drive, 24 x speed CD/DVD read/write drive, 19" XGA monitor, XGA video card, full-size 101-key enhanced keyboard and a mouse.

b. Internet Explorer 6.0 or higher.

c. Windows XP Professional operating system.

d. Optional software as required for system configuration and data logging, as needed.

e. 100% IBM compatible.

f. Adobe Acrobat Reader 9.0.

g. Microsoft Office Professional.

h. 1.5TB External Storage Backup.

i. 900 VA Uninterruptible power supply or inverter, as needed.

j. Auto-reboot capability upon return from power failure. Necessary programs must then automatically launch without user intervention.

k. Two All in One color printers, with 2 spare cartridges for each style required.

The PMCS project shall include 8 station unit "full server" computers with the following features:

a. Minimum CPU module with Intel 1.86 MHz processor, 2 GB SDRAM, 2 USB interfaces on the rear panel, VGA interface for monitor, 4 USB interfaces (V2) for keyboard/mousse, etc., 2 RJ45 interfaces for LAN (10/100/1000 Gigabit Ethernet), 2 COM interfaces, 2 flash cards, 2 GB each.

b. Monitored by SNMP, HW Watchdog.

c. Temperature/voltage monitoring live contact.

d. Windows XP Embedded service pack 2.

e. SICAM PAS software pre-installed.

f. SICAM PAS license/dongle (USB-version).

g. 125Vdc power supply.

h. Optional software as required for system configuration and data logging, as needed.

2.1.3 Field Wiring, Cabling, and Terminal Blocks

Internal wiring in factory pre-wired enclosures shall be installed according to the Contractor's standard as to wire size, insulation, and method of termination on internal equipment. The individual conductors of the interconnecting cables shall meet the flame resisting test requirements of NEMA WC 74. Each individual conductor in individual enclosures shall be uniquely identified in accordance with NEMA ICS 1. Splices shall not be permitted.

Rail mounted compression clamp terminal blocks shall be provided for conductors requiring connection to circuits external to the specified equipment, and shall be suitable for up to 12 AWG wire. Terminal blocks for analog circuits shall be knife switch disconnecting type. Terminal blocks shall be grouped for easy accessibility unrestricted by interference from structural members and internal devices. Sufficient space shall be provided on each side of each terminal block to allow an orderly arrangement of all leads to be terminated on the block. Plastic wiring duct or other factory mounted cable support devices shall be provided to support cables for external circuit wiring.

Terminal blocks, interposing relays, switches, or similar devices shall be readily accessible. The equipment shall be located in compartments, enclosures, or junction boxes in such arrangement that maintenance personnel shall have direct access to the equipment without removal of barriers, cover plates, or wiring. Grouped terminal blocks for all external connections shall be provided. All wiring leaving an enclosure shall leave from terminal blocks or prefabricated connectors and not from other devices in the enclosure. Terminal blocks and jumpers shall be permanently and uniquely marked in conformance with NEMA ICS 1.

2.1.4 Power Supplies

Field equipment shall be powered from 125 Vdc, 120 Vac derived from a 2000 VA inverter, or powered from local emergency panel with a ups backup.

2.1.5 Enclosures

Enclosures shall conform to the requirements of NEMA 250 for the types specified. Damaged surfaces shall be repaired and refinished using original type finish. Enclosures shall have removable hinged, key-locked front doors. All enclosure locks shall be keyed alike. A total of 5 keys shall be turned over to the Government.

2.1.6 EMI/RFI Compliance

Equipment shall be designed to minimize the generation of electromagnetic and radio frequency interference. Workstation equipment shall be in compliance with 47 CFR 15, for Class B computing devices.

2.2 FIELD EQUIPMENT

2.2.1 Basic Intelligent Electronic Device (IED)

2.2.1.1 Revenue Accurate Multifunction Power Meter with harmonics, waveform recording, data logging and set point control.

Provide a high accuracy power meter meeting the requirements set forth in this specification. Note any exceptions taken with a detailed description.

a. Meter shall be Siemens Type 9350 Power Meter, or approved equal, with options and features described in this section.

Meet the following recognized standards for application in hardened environments.

a. Device must meet all international standards for Safety and Construction applicable to this type of device:

1. UL 3111

2. CAN/CSA C22.2 No. 1010-1

3. IEC 1010-1

4. CE Marked

b. Device must meet the following international standard for Electromagnetic Immunity applicable to this type of device:

1. IEEE C37.90-1989 IEEE Standard Surge withstand capability Tests for Protective Relays and Relay Systems (ANSI) (All inputs except for the network communication port).

c. Device must meet the following international standard for Electromagnetic Emissions:

1. FCC: Part 15 of FCC Rules for a Class A digital device.

d. Device must provide measurement accuracy that meets or exceeds ANSI C12.16 Class 10

e. Basic hardware requirements of the Multifunction Power Meter are as follows:

1. Voltage Inputs: The device shall have three voltage inputs. The voltage inputs shall be capable of measuring from 0-347Vrms (line-to-neutral) or from 0-600Vrms (line-to-line). The device shall have provisions for direct connection (require no PT's) for Wye (Star) systems up to 347/600 VAC. For higher voltage systems, PT's with 120 VAC, 277 VAC or 347 VAC secondaries shall be supported. All voltage inputs shall provide:

    a) 1500VAC continuous surge protection.

    b) 25% of full-scale voltage overrange capability.

2. Current Inputs: The device shall have three 5A nominal (10A full scale) current inputs. All current inputs shall be transformer coupled and accept CTs with 5A nominal (10A full scale) outputs. All current inputs shall provide:

    a) 300A surge protection for 1 second.

    b) 25% of full scale current continuous overrange capability.

3. Power Supply: The PMAC instrument shall be powered from 85VAC to 240VAC @ 20 to 440Hz, or 110VDC to 300 VDC, or 20-60 VDC power source. Worst cast loading shall not exceed 10W.

4. On-board I/O: The device supplied shall have the following built-in I/O for this project:

    a) Four digital (status) inputs.

    b) Four optically isolated, Darlington transistor digital (status) outputs with the following features:

        1. Any of the outputs shall have the ability to be used to provide pulse outputs according to any energy consumption levels.

        2. All outputs shall be scaleable to +/-1,000,000,000 units/pulse.

    c) Four (4) analog I/O user selectable from:

        1. Four 0-20 mA inputs and four 0-20 mA outputs.

        2. All analog inputs and/or outputs are accurate to within 0.3% of full scale.

5. Provisions for future external I/O: The device shall also support the following provisions for I/O for future applications of the device. The external I/O can support up to 4 digital output devices and shall support the following devices:

    a) 120 VAC, 3.5A, N.O. Solid State Relay

    b) 120 VAC, 3.5A, Zero Voltage Turn On, Manual Override Relay

    c) 240 VAC, 3.5A, N.O. Solid State Relay

    d) 240 VAC, 3.5A, Zero Voltage Turn On, Manual Override Relay

    e) 60 VDC, 3.5A, N.O. Solid State Relay

    f) 60 VDC, 1.5mA, Zero Voltage Turn On, Manual Override Relay

    g) 60 VDC, 1.0A, Low Leakage, N.O. Solid State Relay

    h) 200 VDC, 1.0A, N.O. Solid State Relay

    i) 100 VDC, 0.5A, N.O. Mechanical Relay

6. Communications

    a) Provide the following built-in ports in the purchased configuration. All communication ports shall be standard technology, as defined by the IEEE. No communication interfaces not defined by the IEEE shall be accepted:

        1. Two optically isolated RS-485 communications ports, supporting data rates from 1200 up to 19200 bits per second.

        2. One front panel infrared optical port for RS-232 communications, supporting data rates from 1200 up to 19200 bits per second. This port shall support an ANSI Type II optocoupler.

        3. Optional communications shall be available to provide.

        4. An Ethernet port that has EtherGate capability - a gateway that allows the host system to communicate (through the Ethernet port) to additional metering devices connected to the card's COM2 RS-485 port. The device shall have provisions for an internal Ethernet port compatible with 10Base-T Ethernet. The Ethernet port shall be terminated using an RJ-45 connector.

b) All communications ports in this section must support all of the following communication capabilities, independently configurable:

1. SEAbus/ION protocol

2. Modbus RTU protocol

3. DNP 3.0 Protocol

4. Shall provide simultaneous access through all communications ports to any measured or derived parameter.

5. Protocols must be field configurable from the front display or via communications ports. This must be capable of being accomplished without resetting the meter, or interrupting its operation in any way.

6. Shall have provisions for flash firmware that can be field upgraded through any communications port, without de-commissioning the instrument or de-energizing the circuit or equipment. The firmware upgrade procedure shall be robust and able to recover from power failure during an upgrade.

7. Support time synchronization broadcast messages from a host computer system.

7. Mounting and Display

a) The device shall be support the following mounting options:

1. Din standard 92mm x 92mm (3.6 in x 3.6 in) panel cutout, using sliding clamps tightened by thumbscrews.

2. Transducer type base unit with a remote backlit LCD display (display cable included) for remote display applications.

3. Transducer type base unit only with no display locally mounted.

4. Allow the user to remove and replace the display panel without removing the instrument from the equipment in which it is mounted.

b) The device shall support the following front panel display options:

1. Have programmable buttons that allow access to 8 data display screens.

2. Be capable of displaying any measured parameter with its corresponding label using any of the following configurations:

   i. Display any 4 parameters simultaneously using alphanumeric characters.

   ii. Display any 2 parameter simultaneously using large alphanumeric characters.

   iii. Display any parameter using very large alphanumeric characters.

   iv. Display basic Voltage, Current and Power readings using extra large alphanumeric characters.

   v. Allow the user to change parameter labels.

   vi. Feature a programmable time-out interval and adjustable contrast.

8. The device shall include 512 KB of memory (NVRAM) to store the following:

   a) All set-up data.

   b) A time-stamped event log with the following features:

      1. The device shall support at least 500 events.

      2. The number of records in the log shall be programmable.

      3. Each event record shall record the date and time of the event, the cause and effect of the event and the priority of the event.

      4. All events relating to set point activity, relay operation and self-diagnostics shall be recorded in the event log.

      5. Time stamps shall have a resolution of 1 millisecond.

      6. Time stamps shall be able to be synchronized to within 100 ms between devices on the same serial communications medium.

      7. Minimum event recording response time shall be 1 second.

      8. The priority of set point events shall be programmable.

c) Six (6) programmable data recorders that can each store up to 16 channels of historical trend data with the following features:

1. Each data recorder shall be able to record any parameter, either measured or derived.

2. Each data recorder shall be enabled and triggered manually or through internal operating conditions, including periodic timer or set point activity.

3. The number of records (depth) of each data recorder and the overflow conditions (stop-when-full or circular) shall be programmable.

4. Memory shall be dynamically allocated between data recorders and event log to allow storage of any 16 parameters at 15 minute intervals for not less than 30 days.

5. Min/Max data for any monitored parameter.

9. Devices equipped with an Ethernet port must be Internet enabled to include:

a) MeterM@il®: Automatically e-mail alarm notifications or scheduled system status updates. E-mail messages sent by the devices can be received like any ordinary e-mail message. Data logs can also be sent on an event-driven or scheduled basis.

b) WebMeter™: Built in web pages in the device enable access to real-time values and basic power quality information using a standard web browser. Basic configuration of the device can also be performed through the browser.

c) XML compatible: Supports easy integration with custom reporting, spreadsheet, database and other applications. The device shall accommodate high speed Modbus TCP communications when connected to Ethernet Port 502.

10. The metering device shall provide basic sag/swell detection (over 4 cycles in duration) on any voltage channel; records instantaneous values and waveforms.

11. The device shall record waveforms and simultaneously capture events on all channels, up to 48 cycles each (resolution up to 64 samples per cycle).

12. The device shall provide harmonics analysis up to the 31st harmonic.

13. The device shall include dial-out capabilities (through the ION® Alert module) to notify personnel of critical alarms.

14. The device shall be capable of measuring and calculating the following information, at 1-second intervals.

    a) Voltage line-to-neutral and line-to-line for each phase and average of all three phases.

    b) % voltage unbalance

    c) Current for each phase and average of all three phases.

    d) % current unbalance

    e) kW for each phase and total of all three phases.

    f) kVAR for each phase and total of all three phases.

    g) kVA for each phase and total of all three phases.

    h) kWh for total of all three phases, provided as accumulating import, export, net and total readings.

    i) kVARh for total of all three phases.

    j) kVAh for total of all three phases, provided as an accumulating net reading.

    k) Power factor for each phase and total of all three phases.

    l) Frequency

    m) Harmonic distortion for each voltage and current input, provided as individual harmonic magnitudes up to the 31st harmonic and as total odd, total even and total overall harmonic distortion; all readings given as a percentage of fundamental.

    n) K-Factor calculations of the first 31 harmonics for all current inputs.

15. The device shall provide a User Interface with features as follows:

    a) The device shall be capable of calculating the following information for any reading at 1-second intervals:

        1. Thermal demand calculations for any parameter, with user-programmable length of demand period to match local utility billing method.

2. Sliding window demands for any parameter with user-programmable length of demand period and number of sub-periods to match local utility billing method.

3. Predicted Demand calculations of sliding window demand parameters, with user-programmable predictive response characteristics.

4. Minimum value for any measured parameter.

5. Maximum value for any measured parameter

6. Derived values for any combination of measured or calculated parameter, using the following arithmetic, trigonometric and logic functions (equivalent PLC capabilities):

    i. Arithmetic functions: division, multiplication, addition, subtraction, power, absolute value, square root, average, max, min, RMS, sum, sum-of-squares, unary minus, integer ceiling, integer floor, modulus, exponent, PI.

    ii. Trigonometric functions: COS, SIN, TAN, ARCCOS, ARCSIN, ARCTAN, LN, LOG10.

    iii. Logic functions: =, =>, <=, <>, <, > and, OR, NOT, IF.

    iv. Thermocouple linearization functions: Type J, Type K, Type R, Type RTD, Type T.

    v. Temperature conversion functions: C to F, F to C.

b) The device shall support direct display of all parameters on the front panel or remote display in user programmable groups, using plain language labels. Simultaneous access to all parameters shall be available through any communication port.

c) The device shall be field programmable as follows:

1. Basic parameters: Voltage input scale, voltage mode (wye, delta, single phase), current input scale, auxiliary input and output scales and communications setup parameters are programmable from the front panel.

2. All basic parameters described above, plus additional set point/relay and data log setup parameters may be programmed via the communications port using a portable or remotely located computer terminal.

3. Using ION modules, support customized configurations of all operating parameters.

4. Provisions shall be made to ensure that programming through a computer can be secured by user ID and password.

5. Provisions shall be made to ensure that programming through the front panel is secured by password.

d) The device shall have provisions for creating periodic or non-periodic schedules for up to two (2) years. These schedules may be used to perform the following functions:

1. Demand Control

2. Load Scheduling

3. Logging

4. Periodic Resetting

16. Alarming and set point control shall be supported The following features are the minimum requirements for this function:

a) The device shall provide set point control of internal recording mechanisms and all digital output relays as follows:

1. 12 programmable set points shall be provided, each of which can respond to out-of-range and alarm conditions for any measured parameter.

i. Each set point shall have 1 second minimum response time.

ii. Each set point shall have programmable pick-up and drop-out levels (high and low limits) and time delays on operate and release.

iii. Activity of each set point shall generate an event of a programmable priority. Priority levels shall support up to 256 levels of alarm severity.

iv. Any set point shall be programmable to any operating condition and any number of available set points shall be concurrently programmable to operate on a particular condition to support multiple threshold conditions.

v. Set points shall be programmable to operate on any over or under condition for:

I. Any voltage or current input or average,

II. Voltage or current imbalance,

III. kW or kVAR forward or reverse,

IV. kVA,

V. Power factor lag or lead,

VI. Frequency,

VII. kW or current demand on any phase or total or average,

VIII. Individual harmonic distortion on any phase input,

IX. Total harmonic distortion on any phase input,

X. Total even or odd harmonic distortion on any phase input,

XI. Any maximum or minimum value,

XII. Multiple energy accumulation conditions,

XIII. Phase reversal,

XIV. Pulse counts levels,

XV. Any internally derived value

2. Any set point condition shall be able to control any number of digital output relays in an AND or an OR configuration, using pulse mode or latch mode operation, for control and alarm purposes. Digital outputs shall also be operable remotely via any communications port.

3. Any set point condition shall be able to provide breaker trip relay operation.

4. Consecutive alarm conditions and triggers shall be supported with no “dead” time between events (i.e. there shall be no need for a rearming delay time

between events).

2.2.1.2 Advanced Web Enabled Revenue Accurate Power Quality Meter with Sub-Cycle Transient Detection

Provide a high accuracy power meter meeting the requirements set forth in this specification. Note any exceptions taken with a detailed description.

a. Meter shall be Siemens Type 9610 Power Meter or approved equal, with options and features described in this section.

b. Provide Power Quality Meter on all incoming switchgear or switchboards mains and as indicated on the drawings.

Meet the following recognized standards for application in hardened environments

a. Device must meet all international standards for Safety & Construction applicable to this type of device:

1. UL3111-1

2. CSA C22.2 No 1010-1

3. IEC1010-1 (EN61010-1)

b. Device must meet all international standards for Electromagnetic Immunity applicable to this type of device:

1. IEEE C.37-90.1-1989 IEEE Standard Surge Withstand Capability (SWC) Tests for Protective Relays and Relay Systems (ANSI) (All inputs except for the network communication port)

2. IEC1000-4-2 (EN61000-4-2/IEC801-2) Electrostatic Discharge (B)

3. IEC1000-4-3 (EN61000-4-3/IEC801-3) Radiated EM Field Immunity (A)

4. IEC1000-4-4 (EN61000-4-4/IEC801-4) Electric Fast Transient (B)

5. IEC1000-4-5 (EN61000-4-5/IEC801-5) Surge Immunity (B)

6. IEC1000-4-6 (EN61000-4-6/IEC801-6) Conducted Immunity

7. ANSI C62.41 Surge Immunity

8. IEC1000-3-2 (EN61000-3-2) Limits for harmonic currents emissions (equipment input current < 16 amps per phase).

9. IEC1000-3-3 (EN61000-3-3) Limitation of voltage fluctuations and flicker in low voltage supply systems for equipment with rated current < 16 amps.

10. ENV51040 Radiated EM Field Immunity (A)

11. ENV51041Conducted EM Field Immunity (A)

12. EN50082-2 Electromagnetic Compatibility, immunity

c. Device must meet all international standards for Electromagnetic Emissions

1. FCC Part 15 Subpart B, Class A Class A Digital Device, Radiated Emissions

2. EN55011 (CISPR 11) Radiated/Conducted Emissions (Group 1, Class A)

3. EN55022 (CISPR 22) Radiated/Conducted Emissions (Class A)

4. EN50081-2 Electromagnetic Compatibility, emissions

d. Device must comply with IEC687 S0.2

e. Device must provide measurement accuracy that meets or exceeds ANSI C12.20 CA0.2

f. Basic hardware requirements of the Power Quality meter are as follows:

1. Voltage inputs: The device shall have five voltage inputs (V1, V2, V3, V4, and Vref). The voltage inputs shall be capable of measuring from 0 to 347 Vrms (line-to-neutral) or from 0 to 600 Vrms (line-to-line). The device shall have provisions for direct connection (require no PT's) for Wye (Star) systems up to 347 VAC (line-to-neutral) or 600 VAC (line-to-line). The device shall also have provisions for direct connection to Delta systems (with allowance of accuracy degradation of 0.15%) up to 277 VAC (line-to-neutral) or 480 VAC (line-to-line). All voltage inputs shall provide:

a) Dielectric withstand of 3250 VAC rms, 60 Hz for 1 minute.

b) Overload protection of 1500 VAC rms continuous.

c) Fault capture to 1400 V peak at the device terminals.

2. Current inputs: The device shall have five current inputs (I1, I2, I3, I4, and I5). The current inputs shall be capable of measuring up to 20 A rms (600 V rms maximum voltage). All current inputs shall provide:

a) Dielectric withstand of 3250 VAC rms, 60 Hz for 1 minute.

b) 500 A rms for 1 second, non-recurring.

c) Fault capture to 50 A rms or 70 A peak at the device terminals.

3. Power supply: The device shall accept power from 85-240 VAC (+/-10%), 47 to 63 Hz or 110-330 VDC (+/-10%) without external converters or separate ordering options. Maximum burden shall be 20 VA. Ride-through shall be a minimum of 100ms (6 cycles @ 60Hz) for 96 VAC, or 200ms (12 cycles @ 60 Hz) for 120 VAC or 800ms (48 cycles @ 60 Hz) for 240 VAC. Dielectric withstand shall be 2300 VAC rms, 60 Hz for 1 minute.

4. On-board I/O: The device supplied shall have the following built-in I/O for this project.

a) Three (3) Form C dry contact relays rated for switching of 2500 VA resistive.

b) Four (4) Form A solid state outputs.

c) 8 Digital inputs (S1 to S8, SCOM), self-excited dry contact sensing, no external voltage required, +30VDC differential between SCOM and S1 through S8 inputs.

d) The following additional I/O may be added through the application of one of the following I/O cards. Meter must be able to be field retrofit to upgrade to include these cards.

i. Four (4) 0 to 1 mA analog inputs and 8 digital inputs.

ii. Four (4) 0 to 20 mA analog inputs and 8 digital inputs.

iii. Four (4) -1 to 1 mA analog outputs and 8 digital inputs.

iv. Four (4) 0 to 20 mA analog outputs and 8 digital inputs.

v. Four (4) 0 to 20 mA analog inputs, four 0 to 20 mA analog outputs and

8 digital inputs.

vi. Four (4) 0 to 1 mA analog inputs, four -1 to 1 mA analog outputs and 8 digital inputs.

5. Communications

a) Provide the following built-in ports in the purchased configuration. All communication ports shall be standard technology, as defined by the IEEE. No communication interfaces not defined by the IEEE shall be accepted.

i. Standard communications card: includes RS-232/RS-485 (COM1), RS-485 (COM2), programmable for baud rates from 1200 to 115200 bits per second.

ii. An IrDA optical port at the face of the meter display for quick downloading of meter information with the IrDA port on a laptop.

b) Meter must be able to field retrofit to upgrade to the following built-in port options:

i. 10baseT Ethernet connection

ii. 10baseFL Ethernet option (Fiber connection)

iii. 33.6kbps Modem

c) All communication ports in this section must support all of the following communication capabilities, independently configurable:

i. SEAbus/ION protocol

ii. Modbus RTU protocol

iii. DNP 3.0 protocol

iv. Independent communications from each port simultaneously with no noticeable interruption of communications from any of the other communication ports.

v. Protocols must be field configurable from the front display or via communications ports. This must be capable of being accomplished without resetting the meter, or interrupting its operations in any way.

vi. Modem and Ethernet port options must support simultaneous communication to the meter in question and gateway capability to other RS485 devices on the network via the meter's RS485 ports.

vii. Support upgrade of the instrumentation firmware.

viii. Support time synchronization broadcast messages from a host computer system.

ix. Support time synchronization to GPS time signal.

6. Display shall be 1/4 VGA, bright graphical FSTN LCD (320x240 pixel resolution) with:

   a) Ability to display meter data in multiple intuitive formats at the meter display, with a minimum of the following types of screens.

      i. 3 lines of 1/2" characters for easy viewing of critical power information.

      ii. 20 real time values on one display for summary overview of currents and voltages or power readings.

      iii. Display graphical vector representation of all 3 phase voltages and currents, updated in real time at the meter display, for quick determination of improper wiring and unusual system conditions without the need of a computer.

      iv. Display graphical charts of all harmonics (up to the 63rd harmonic) for each phase voltage and current.

      v. Display recent events written to the devices event log, including diagnostic events.

      vi. Display information from any measured parameter as a trend including magnitude and time.

7. The device shall include 4 MB (optional 8MB) of memory (NVRAM) to store the following:

   a) All setup data.

b) A time-stamped event log supporting at least 500 events with 1ms resolution shall record the following information about each event:

i. Time of event

ii. Cause of event

iii. Effect of event

iv. Device output reactions

v. Priority of event

c) Forty (40) Data Recorder Modules that can each store up to 16 channels of historical trend data with the following features:

i. Each data recorder shall be able to record any high speed (½-cycle) or high accuracy (1-second) parameter, either measured or derived.

ii. Each data recorder shall be enabled and triggered manually or through internal operating conditions, including periodic timer or set point activity.

iii. The number of records (depth) of each data recorder and the overflow conditions (stop-when-full or circular) shall be programmable.

d) Min/Max data for all monitored parameters.

e) Waveform recordings as described in the power quality paragraph below.

8. Devices equipped with an Ethernet port must be Internet enabled to include:

a) MeterM@il®: Automatically e-mail alarm notifications or scheduled system status updates. E-mail messages sent by the devices can be received like any ordinary e-mail message. Data logs can also be sent on an event-driven or scheduled basis.

b) WebMeter™: Built in web pages in the device enable access to real-time values and basic power quality information using a standard web browser. Basic configuration of the device can also be performed through the browser.

c) XML compatible: Supports easy integration with custom reporting, spreadsheet,

database and other applications.

9. The device shall accommodate high speed Modbus TCP communications when connected to Ethernet Port 502.

10. The PMAC instrument can be used for compliance monitoring to the following standards:

    a) EN50160 compliance monitoring

    b) IEC 61000-4-7 harmonics and inter-harmonics

    c) IEC 61000-4-15 flicker

    d) CBEMA/ITIC

    e) IEEE 519 and IEEE 1159

11. The PMAC instrument has the ability to perform the following functions without the need for separate software:

    a) Determine statistical indicators of power quality parameters that include but are not limited to flicker, dips and swells, harmonics ad interharmonics, in accordance with the EN50160 standards, “Voltage characteristics of electricity supplied by public distribution systems”.

    b) Evaluate power quality statistically in accordance with IEC 61000-4-7, IEC 61000-4-15, CBEMA/ITIC, IEEE 1159 and IEEE 519.

    c) Make available the statistical indicators of power quality on the front panel display, or via communications over any supported protocol (ION, Modbus RTU, Modbus TCP, DNP 3.0, IEC870-5), or via an analog transducer interface.

    d) Internally record the value of statistical indicators of power quality at regular intervals and make these data records available through communications or on the front panel display so that it is easy to determine the trend of these power quality statistics.

    e) Monitor the value of any statistical indicator of power quality (present, predicted, average or otherwise manipulated value) with an absolute or relative set point. When such set point is exceeded, issue an alert via e-mail or pager, or enable control via a local interface to mitigation equipment or control systems through relays and analog or digital outputs.

12. The device shall provide technology and functionality to provide high end Power Quality monitoring as follows:

a) Continuously sample at 256 samples per cycle on all voltage and current inputs to support high-end power quality requirements.

b) High-speed sag/swell detection of voltage disturbances shall be available on a cycle-by-cycle basis, providing the duration of the disturbance and the minimum, maximum and average value of the voltage for each phase during the disturbance. Disturbances less than one cycle in duration shall be detected.

c) High-speed voltage transient detection, capture and recording: ITIC (CBEMA), IEEE

d) Sixteen (16) programmable oscillographic waveform recorders with the following features:

i. Each waveform recorder shall be able to record a digitized representation of any phase voltage or current signal.

ii. Each waveform recorder shall be enabled and triggered manually or through internal operating conditions, including periodic timer or set point activity.

iii. High speed triggering shall be supported.

iv. The number of records (depth) of each data recorder and the overflow conditions (stop-when-full or circular) shall be programmable.

v. The number of cycles and the sampling frequency for the waveform shall be programmable. The following digitized signal representations shall be available (at 50Hz or 60Hz):

vi. 16 samples per cycle x 96 cycles

e) Harmonics Monitoring

i. On-board calculation of individual harmonics for all phase currents and phase to neutral or phase-to-phase voltages, up to the 128th harmonic.

ii. On-board calculation of total harmonic distortion (up to the 128th harmonic) for all phase currents and phase to neutral or phase-to-phase voltages.

iii. On-board calculation of k-factors for all phase currents

13. The device shall provide a User Interface with features as follows:

a) The device shall be capable of calculating the following information for any reading at 1-second intervals:

i. Thermal demand calculations for any parameter, with user-programmable length of demand period to match local utility billing method.

ii. Sliding window demands for any parameter with user-programmable length of demand period and number of sub-periods to match local utility billing method.

iii. Predicted Demand calculations of sliding window demand parameters, with user-programmable predictive response characteristics.

iv. Minimum value for any measured parameter.

v. Maximum value for any measured parameter.

vi. Derived values for any combination of measured or calculated parameter, using the following arithmetic, trigonometric and logic functions (equivalent PLC capabilities):

I. Arithmetic functions: division, multiplication, addition, subtraction, power, absolute value, square root, average, max, min, RMS, sum, sum-of-squares, unary minus, integer ceiling, integer floor, modulus, exponent, PI

II. Trigonometric functions: COS, SIN, TAN, ARCCOS, ARCSIN, ARCTAN, LN, LOG10

III. Logic functions: =, =>, <=, <>, <, > and, OR, NOT, IF

IV. Thermocouple linearization functions: Type J, Type K, Type R, Type RTD, Type T

V. Temperature conversion functions: C to F, F to C

b) The device shall support direct display of all parameters on the front panel in user programmable groups, using plain language labels. Simultaneous access to all parameters shall be available through any communication port.

c) The device shall be field programmable as follows:

i. Basic parameters: Voltage input scale, voltage mode (wye, delta, and single phase), current input scale, auxiliary input and output scales and communications setup parameters are programmable from the front panel.

ii. All basic parameters described above, plus additional set point/relay and data log setup parameters may be programmed via the communications port using a portable or remotely located computer terminal.

iii. The priority of set point events shall be programmable.

iv. Using ION modules, support customized configurations of all operating parameters.

v. Provisions shall be made to ensure that programming through a computer can be secured by user ID and password.

vi. Provisions shall be made to ensure that programming through the front panel is secured by password.

14. The device shall have provisions for creating periodic or aperiodic schedules for up to two (2) years. These schedules may be used to perform the following functions:

a) Time of Use (TOU)

i. The device shall provide extensive Time of Use (TOU) functionality to store and monitor up to 20 years of seasonal rate schedules. The TOU feature shall allow four seasons, four-day types (each one capable of at least eight switch times, with a resolution of one minute). The TOU feature shall support four rate tariffs and at least twelve holidays per year and shall allow periodic self-read capability.

b) Demand Control

c) Load Scheduling

d) Logging

e) Periodic Resetting

15. Alarming and set point operations shall be supported. The following features are

the minimum requirements for this function:

a) The device shall provide set point control of internal recording mechanisms and all digital output relays as follows:

i. 24 programmable set points shall be provided, each of which can respond to out-of-range and alarm conditions for any measured parameter.

I. Each set point shall have 1-second minimum response time for high accuracy operation and ½ cycle typical response time for high-speed operation.

II. Each set point shall have programmable pick-up and dropout levels (high and low limits) and time delays on operate and release.

III. Activity of each set point shall generate an event of a programmable priority. Priority levels shall support up to 256 levels of alarm severity.

IV. Any set point shall be programmable to any operating condition and any number of available set points shall be concurrently programmable to operate on a particular condition to support multiple threshold conditions.

V. Set points shall be programmable to operate on any over or under condition for:

(1) Any voltage or current input or average,

(2) Voltage or current imbalance,

(3) Neutral/ground current,

(4) kW or kVAR forward or reverse,

(5) kVA,

(6) Power factor lag or lead,

(7) Frequency,

(8) kW or current demand on any phase or total or average,

(9) Individual harmonic distortion on any phase input,

(10) Total harmonic distortion on any phase input,

(11) Total even or odd harmonic distortion on any phase input,

(12) Any maximum or minimum value,

(13) Multiple energy accumulation conditions,

(14) Phase reversal,

(15) Pulse counts levels,

(16) Any digital input conditions

(17) Any internally derived value

b) Any set point condition shall be able to control any number of digital output relays in an AND or an OR configuration, using pulse mode or latch mode operation, for control and alarm purposes. Digital outputs shall also be operable remotely via any communications port.

c) Any set point condition shall be able to provide breaker trip relay operation.

d) Any set point condition shall be able to trigger an internal data or waveform recorder.

e) Consecutive high-speed alarm conditions and triggers shall be supported on a cycle-by-cycle basis with no “dead” time between events (i.e. there shall be no need for a rearming delay time between events).

f) It shall be possible to use any logical combination of any number of available set point conditions to control any internal or external function or event.

g) Digital outputs shall support pulse output relay operation for kWh total, kWh imported, kWh exported, kVARh total, kVARh imported, kVARh exported and kVAh values.

2.2.1.3 Mounting

Basic IEDs shall accommodate mounting in or on switchgear enclosures as required for the installation.

2.3 INSTRUMENT TRANSFORMERS

2.3.1 Potential Transformers

Potential transformers shall be compatible with IEDs furnished. The Contractor shall be responsible for determining the actual voltage ratio of each transformer. Potential transformers shall conform to IEEE C57.13 and the following requirements.

a. Type: indoor, dry type, of two-winding construction

b. Frequency: Nominal 60Hz

c. Accuracy: plus or minus 0.3% at 60Hz

2.3.2 Multi-Ratio Current Transformers

Current transformers shall be compatible with the IEDs furnished. Current transformers shall conform to IEEE C57.13 and the following requirements.

a. Insulation Class: BIL rating shall be equal or greater than

b. the equipment being connected to.

c. Frequency: Nominal 60Hz

d. Accuracy: plus or minus 0.3% at 60Hz

e. Burden: Burden class shall be selected for the load

f. Phase Angle Range: 0 to 60 degrees

2.4 WORKSTATION EQUIPMENT

2.4.1 Workstation Computer

2.4.2 Communications

Each Workstation computer shall be supplied with an internal network interface card for connection to IEEE Std 802.3 Fiber Ethernet LANs. Interface cards shall be supplied with an on-board transceiver for direct connection to the LAN, and with an AUI port for performing diagnostics. Interface cards shall also have an on-board buffer memory to prevent loss of data packets. The LAN shall interconnect and service system local and remote components. The network transmission media shall be Fiber optic cable as defined by TIA/EIA-568-B.1-3. All cabling, patch panels, patch cables, and

accessories shall be provided as required to implement a complete wiring system for the LANs. Connector type shall be Category 5 rated if copper is used. A minimum of one AUI port shall be provided per twisted pair module. Ethernet gateways shall be provided for interface of IED communication channels to the LAN. Ethernet gateways shall accept data from field equipment at the full speed of the field equipment communication channel.

2.5 SYSTEM SOFTWARE

The PMCS Server software shall be designed on a MICROSOFT WINDOWS-based platform and have on-line full-screen editing to facilitate the programming and monitoring of the system. The Power Management Server and Web Based Client locations will allow the monitoring of vital system parameters and provide a scaleable system for future expansions without replacement of the PMCS system hardware or software.

The PMCS screens shall show all parameters which are available from the individual remote devices by device, including but not limited to all metered values, load status, alarm status, energy data, device position and/or status, device data logs, waveform capture, sag/swell events, etc. In addition, the screens shall be capable (if allowed by the owner) of providing for suitable tripping, closing and opening of appropriate remote devices.

The PMCS software shall provide, as standard, the following software packages to allow for maximum flexibility and expandability.

a. The proposed system will include a PMCS system that supports unlimited Web Based clients and the following device point level packages:

    i. Unlimited monitoring points.

b. The PMCS software Web Bases clients shall require No loading of software to view all the PMCS screens and data.

c. The PMCS software shall allow unlimited screens and unlimited screen penetration to lower-level detailed screens.

The base PMCS software package shall have as a minimum the following specified features.

a. System/device alarm logging and reporting: Any changes in any device or the system itself including log on/off, power on/off at system master computer, shall be identified and alarmed.

b. Time/event logging: The time and causes of each event shall be logged directly to the master control unit file and/or a printer. Time stamping capability in seconds shall be

provided at the system master computer of device on/off, device alarm, device trip and device no response.

2.6 COMMAND SOFTWARE

2.6.1 General Features

Command software shall be provided and shall request, receive, and process all real-time values acquired from periodic scans of field equipment and manual data and command entries from operator workstations. The software shall effectively coordinate the field equipment scanning and database updating with the workstation interface, report and event software, and other related calculation and data processing software.

2.6.2 Database Management

2.6.2.1 Real-Time Database

a. A real-time database shall be provided to store and manage the most current calculated, and scanned values.

b. The real-time database shall be designed to handle the total number of IEDs specified in paragraph EXPANSION REQUIREMENTS.

2.6.2.2 Database Editor

The database editor shall enable the operator to add, modify, and delete system IEDs via interactive procedures. The editing software shall dynamically resize tables and files as IEDs are added or deleted. The system shall provide "fill-in-the-blank" displays for editing.

2.6.2.3 Calculated Value

This value shall be created by calculating it from any combination of monitored values and parameters, and other data. The results of the calculation will be a value having all the properties of monitored values without the associated hardware. The calculated point shall be available for use in any display or report.

2.6.3 Scanning

a. The software shall provide the message exchange sequence for scanning, generate necessary commands to retrieve monitored values and parameters, and perform all required error checking to ensure validity of received data, and/or proper completion of the scan sequence. All system malfunctions, including no response from field equipment, incomplete data, or invalid data, shall be reported.

b. The Workstation shall communicate with IEDs on a sequential continuous scan basis.

c. Inclusion or exclusion of any IED from the scanning sequence shall be accomplished from any Workstation.

2.6.4 Error Detection and Retransmission

An error detection algorithm shall be used for data between IED and workstation which shall detect all single and double bit errors, all burst errors of eight bits or less, and at least 99% of all multi-bit and burst error conditions. A message shall be in error if one bit is received incorrectly. The system shall retransmit all messages with detected errors.

Diagnostics shall be provided to provide information on device or system malfunction, such as devices not communicating, watchdog alarms, stale date indication, etc.

2.6.5 User Interface Software

2.6.5.1 General Display Requirements

Displays shall be provided as specified and shown. All displays shall be uniquely labeled. All displays shall include time and date. Displays shall contain any combination of graphic and tabular information. A display shall contain any combination of monitored data from all IEDs, and all displayed data shall be updated as specified in Paragraph: System Response Times.

2.6.5.2 Display Editor

The display editor shall enable an operator with proper password to create, modify, and delete displays. The primary use shall be for adding and modifying one-line diagrams, station status displays, system summaries, and system directories, as field equipment or new data are added.

2.6.5.3 Specific Displays

The PMCS software shall provide the following the screens as standard in the software:

a. Real-time Device information like Line to Line and Line to Neutral voltage and current readings for all Power Meters in a 3-Line diagram format.

b. Event Logs.

c. Alarm Logs.

d. Historical trend plots.

e. Real-time trend plots.

f. Waveform capture display with zoom in/out capability.

g. Harmonic analysis display.

h. Phasor display.

i. Time-of-use display.

j. Power Quality display.

k. I/O status & control display.

l. Set point and setup display.

m. Device log and setup display.

n. CBEMA curve display.

o. Billing Report display in Excel or HTML format.

p. Power Quality Report display including sag/swell counter in Excel or HTML format.

q. Energy Report display in Excel or HTML format.

r. Display EN50160 Report in Excel or HTML format.

s. Network diagram display.

t. One-click access to device logs, including long-term min/max, voltage, current, power, frequency and power factor trending.

u. Display Flicker data tables.

v. All I/O shall be displayed including current state.

w. Device "OPEN", "CLOSED", "TRIPPED" and "COMMUNICATION" status.

x. All measured values supported by the given device as selected by the customer

2.6.5.4 FUNCTIONS OF THE SUBSTATION AUTOMATION SYSTEM

The substation automation system shall serve as a control and monitoring device for operating the switchgear. The operator shall detect the substation status and carry out switching commands from an HMI. The HMI shall be connected to the station unit via the TCP / IP station bus. The substation automation system shall record and processes all switchgear events. Each event shall be accompanied by a real time - time stamp. The origin of this time stamp shall be in the device which acquired the event.

The substation automation system shall fulfill the following functions:

a. IEC 61850

b. Telecommunication

c. Monitoring

d. Automation

e. Online configuration.

f. Local and remote control / control with switchgear interlocking / switching sequences.

g. Serial connection of IEDs and field devices.

h. Connection to a local HMI.

i. Interlocking for Breaker Operation

1. Bay interlocks shall be implemented locally in the respective IEDs. The system shall be capable to do this centrally in the station unit.

2. High ranking station interlocking shall be done by using a generic object oriented substation event (GOOSE) mechanisms between IEC 61850 IEDs.

3. For non-IEC 61850 devices high ranking station interlocking shall be done centrally in station unit.

4. Breaker position shall be set to local or remote at the station unit. The command form the remote control center shall be rejected or executed based on the setting.

j. Bay and Telecontrol Blocking

1. Bay and telecontrol blocking shall be implemented in the substation automation system.

2. When bay blockage is ON for maintenance or test work in a bay, the information flow between the IEDs and the substation automation system shall be blocked in the monitoring and control directions. Bay blockage shall be set device orientated.

3. If the telecontrol blockage is set, the information flow between the substation automation system to the control center shall be suppressed. Telecontrol blockage shall be set device oriented and set channel specifically. It shall be possible to select particular control centers.

k. Switching Authority between SCADA Systems and Local HMI

1. The switching authority shall be implemented in the substation automation system.

2. The switching authority defines which level (field, station or SCADA) is authorized for switching operation. In addition to the local / remote switch on the IED, it shall also be possible to switch between local (HMI) and remote (SCADA) control at the station level. The switching authority shall also be configured to be channel specific, e.g. control center 2 is authorized for switching operation and the other control centers and the local control are not.

l. System Security

1. The electronic components of the substation automation system shall be electromagnetic compatibility.

2. Safety functions shall ensure prompt error or fault signals. Hardware self test and the general interrogation shall be preformed at startup and cyclically in the background during system operation.

m. Interruption of Power Supply

1. All parameters shall be securely stored in a real time database. All applications shall start as services. After a power failure, the substation automation system shall automatically start up again and continue its operation.

n. Communication

1. Faults in the data transmission caused by electromagnetic influences, earth potential differences, aging of components, noise sources on the transmission channels or other disturbances, shall be reliably detected and transmitted.

2. The safety procedures of the protocols shall detect:

i. Bit and message errors.

ii. Loss of information or repetition.

iii. Faulty information items.

iv. Separation or corruption of contiguous information items.

o. Priority Controlled Message Preparation

1. Messages activated by events shall be prioritized and made available to the system according to their status. The following transmission lists or procedures shall be used:

i. Scan list.

ii. Initiation buffer.

iii. Basic cycle list.

iv. Telegram buffer with time tag.

v. Telegram buffer without time tag.

vi. Counter-controlled list.

vii. Time- controlled list.

p. Grouped Messages

1. It shall be possible to collect several single alarms in a single grouped alarm indication. This shall be done with via the graphical interface. One grouped alarm message shall be sent to the control center.

2.6.6 System Access Control

Password Protection: The following password security protection features shall be provided:

q. The PMCS software shall be capable of having an unlimited number of separate user-

defined passwords.

r. All actions; i.e., log on/off, device control, alarm acknowledgment, etc. shall be time and date stamped in the event log.

s. Password security access shall provide for flexible functional access. Functions such as alarm acknowledgment, device control, device configuration, etc. shall be individually customized to each user name assigned.

t. The PMCS software password security shall be capable of being utilized for both local and remote computers. Individual operator passwords shall be required at every computer location. Each operator's capability to interface with the system shall be keyed to his/her entered password and his/her associated security level at each designated station.

2.6.7 Trending

2.6.7.1 Software General Requirements

a. The trending software shall maintain data files for a minimum of 64 data trends. Any monitored or calculated value shall be trendable. Each data trend file shall retain a minimum of 500 data samples. The time rate of sampling shall be selectable on an individual trend basis. The data files shall be maintained with new data "pushed" in and the oldest data overwritten.

b. The monitor shall display at least four trend values per window with separately selectable amplitude scales and time scales for each window. The time line programming shall allow for time scale references to be presented in a visual format that is representative of the application. As each new data line is written on the display, all previous entries shall be advanced to the next sequential element position. Time lines shall automatically move with each data point such that the time reference is always correct.

c. An operator shall be able to enter upper and lower limits for each trend.

d. The system shall provide for dynamic line and bar graphs, illustrating an analog value through a horizontal or vertical bar. The color of the bar graph shall be user-specified.

e. The trending software shall allow at least eight colors to be used for different trends.

f. The trending system shall include indication of alarm conditions.

g. The system shall support the presentation of data with time on the X-axis (horizontal) and amplitude on the Y-axis (vertical). A minimum of 24 1-hour divisions and 31 1-day

divisions shall be displayed on the X-axis. The start and end date/time shall be operator definable.

2.6.7.2 Trend Description Fields

Each trend display shall include the following trend user-definable description fields.

a. Variable name

b. Amplitude scale

c. Amplitude designation (engineering units)

d. Time units per division

2.6.7.3 Trend Functions

The trending system software shall support the following trend functions.

a. Trend data from history file without active update.

b. Trend data with active update and trend history from time of request to present (no prior history).

c. Trend data with active update and with prior history from a trend history file.

2.6.7.4 Storage of Trend Files

A user shall be able to select any combination of trend files for storage on hard disk. The files shall be automatically saved after a user-selectable number of trend values.

2.6.8 Report Generator

2.6.8.1 Required Software Features

Software shall be provided with commands to generate and format both tabular and graphical reports (including bar charts, pie charts and curve plots) for displaying, printing, and storing on hard disk. Reports shall be stored by type, date, and time. The destination of each report shall be selectable by the user. Reports shall use database dynamic values and parameters, values calculated using the database, and reports stored on disk or tape. Reports shall be spooled allowing the printing of one report to be complete before the printing of another report commences. Parameters used in reports shall be assignable by the user. Reports shall be processed to avoid interference with normal workstation computer tasks. The report shall contain the time and date when the sample was taken,

and the time and date when the report was printed. Reports shall be user-definable to show information in the system database. The system shall allow for the operator to request an immediate printout of any report at any time.

2.6.8.2 Creation of Reports

a. Status Report: The system shall include software to produce reports on the current status of any equipment or parameters in the data base, including:

1. An individual IED.

2. A list of equipment or monitored values, by category, such as substation, building, unit, and type of monitored value.

b. Profile Reports: The software shall provide for generating profile reports by sampling and storing defined parameters on an operator assignable and selectable time interval basis such as an interval of 15 minutes for a period of 1 month and shall include:

1. Power consumption (value vs. time).

2. Average power demand (value vs. time).

3. Equipment subsystem profiles (value vs. value or value vs. time.

4. Provide for 32 profile reports each having up to 1000 samples of up to 8 parameters.

2.6.8.3 Standard Reports

The following standard reports shall be provided:

a. Electrical Power Utilization Report: An electrical power utilization summary, user selectable for individual meters or transducers, any group of meters or transducers, and all meters or transducers on a daily and a monthly basis. The report shall include:

(1) Total daily kWh consumption.

(2) Total monthly kWh consumption for period beginning on user selectable day of the month.

(3) Demand interval kWh peak for the month and day, with time of occurrence.

(4) kWh consumption over each demand interval.

(5) Average kW demand during the interval containing the utility company's peak demand.

(6) Average kW demand during the interval containing the base's peak demand.

(7) Time-of-use peak, semi-peak, off-peak, or baseline total kWh consumption.

b. Alarm Report: All current alarms or all alarms occurring within a user-specified period by IED, building, substation, installation, and the entire system, including time of occurrence.

c. Analog Limit Report: An analog limit and differential summary selectable to describe a single analog value, all analog values within an IED, all analog values within a building, and all analog values for the project.

(1) Analog value.

(2) Engineering units.

(3) High limit.

(4) Low limit.

(5) Analog value change differentials.

d. Static Database Reports: A listing of the values of fixed parameters and constraints defining the characteristics of the system. Provide operator commands to list the entire static database or to list an operator selected building, substation, unit, or IED. Each value listed shall be identified in English.

e. Real-Time Database Reports: A list of the values of dynamic variables including all measured values and calculated values. These variables shall include year, month, day, hour, and minute on the report. Operator commands shall allow for listing the entire real-time database or to list a user selected building, substation, unit, or IED. Each value listed shall be identified in English.

f. Waveform Reports: Graphical displays of captured waveform data, tagged by location (substation or IED), date and time.

2.6.9 Alarm Processing

The software shall allow the user to set an unlimited number of individual computer alarm levels for all monitored parameters, such as setting low and high alarm levels for voltage, current, motor run time, etc. These alarm levels shall be independent of device built-in alarm levels. The alarm settings shall support signed values (+/-) as well as high and low limits.

The software shall support setting multiple limits, providing additional alarm points above or below the initial limit.

The software shall display the analog value that caused the alarm on the alarm screen (time and date stamped) and log same information to the event file.

The software shall be capable of taking the following actions based on any alarm:

a. Display custom text in a popup screen at the Power Management Engineering Stations

b. Display any animated diagram based on the activation of the alarm

c. Play any *.wav file accessible by the Power Management Engineering Station

d. Loop the playback of the *.wav file until an operator acknowledges the alarm

e. Activate any output on any power monitoring device in the system, as determined by the owner.

f. Page any alphanumeric pager with descriptive, customizable text on the nature and location of an alarm.

g. Fax descriptive, customizable text on the nature and location of the alarm

The PMCS system shall communicate to each breaker’s microprocessor based trip units, protective relay and any digital meters on the electrical distribution system defined in this specification. Additional analog and discrete statuses required to be monitored by this specification shall be tied back to I/O units and communicated back to the power monitoring software.

2.6.10 Historical Data Processing

2.6.10.1 System General Requirements

The system shall process all real-time values and store user-selectable values for use at a later time. It shall store scanned values on a periodic basis, the maximum value for a point which occurred within a given time, or a calculated value. It shall generate reports using the historical data base processor and the reporting software All historical information shall initially be stored. The tape drives shall store data in a form that allows historical reports to be readily prepared from the media. Historical trend files saved to the tape drives shall be recallable both as a trend file and as tabular data. All historical data shall be written to appropriately structured files on the workstation computer's hard drive, which shall function as a 30-day buffer. After the 30-day period is over, the system shall prompt the operator to archive the data to tape.

2.6.10.2 DDE Data Export

Software shall be provided to implement Dynamic Data Exchange (DDE) for export of historical data to an Excel spreadsheet or other application. Data shall be stored in an Open Data Base Connectivity (ODBC) compliant format.

2.6.10.3 Waveform Data Processing

The system shall store waveform data for display and printing.

2.7 FIELD EQUIPMENT SOFTWARE

The Contractor shall provide software necessary to accomplish the following functions, fully implemented and operational, within the field equipment.

a. Scanning of inputs.

b. Averaging or filtering of inputs.

c. Display of values.

d. Report to workstation of values.

e. IED diagnostics.

2.8 INITIAL STOCKS

The Contractor shall furnish the stocks as specified below. All initial quantities shall be in addition to those needed for running the PVT.

a. One toner cartridge for each laser printer.

b. Ten new flash drives with a capacity of 8 Gbytes.

2.9 COMMUNICATIONS CHANNELS

The Contractor shall provide communications channels as shown between the IEDs and workstations as specified in Sections 27 21 10.00 10 FIBER OPTIC DATA TRANSMISSION SYSTEM. The Contractor shall use Government-furnished communications channels where shown.

2.10 LAN SOFTWARE

The LAN software shall provide for transparent communication with any node on the network. LAN software shall support operation of the system configured as shown. A network operating system shall be supplied as part of the LAN software. The network operating system shall support central and remote database maintenance, servers, file transfer, security, and job entry. A configured and operational shell menu interface shall be provided, and shall be user-configurable.

2.11 PMCS STANDARD GRAPHIC DISPLAY FEATURES

The PMCS installation shall include as standard a graphical package that allows custom-developed graphic screens to match customer one-line drawings, customer floor plan or actual power distribution equipment front elevations, as agreed upon by owner. Owner shall be able to select colors, numbering scheme and general arrangement of screens.

The PMCS system shall include custom graphical screens, as required.

a. The Graphical construction utility and any licenses shall be included.

b. Standard graphical pictures for analog dials, bar charts, hot-link buttons, etc. shall be included. No additional software will be required to add pictures or links to the software.

c. The Graphical package shall provide a master overview screen listing all subscreens by contract designation and from which any subscreen can be selected by mouse click operation.

d. The Graphical package shall support breaker position (where supported by the device), loading levels and links to real-time screens of individual devices represented on the active screen.

e. The Graphical package shall allow unlimited users to view and modify the custom drawings.

f. The Graphical package shall have the ability to turn logging on and off from the graphical interface screen with one-click access.

Animation (changing of color) of any object or line on the screen based on a change of incoming monitored data and/or a software-performed calculation shall be provided. For example, changing of the single-line bus color based on open or closed status of a circuit breaker or starter.

2.12 Protective Devices

Provide communicating Protection and Control Devices compatible with the PMCS system in the distribution equipment provided. Refer to the following sections for specifics on the functions and features required for each Protection and Control device:

a. Section 26 11 16 SECONDARY UNIT SUBSTATIONS

b. Section 26 23 00 SWITCHBOARDS AND SWITCHGEAR

c. 33 75 00.00 40 HIGH VOLTAGE SWITCHGEAR

2.13 Substation Industrial Ethernet Managed Switch

Provide 24 port industrial Ethernet managed switches designed to meet the extreme requirements of power substations, traffic control, railway and other harsh environments. They shall combine the high performance and security of an enterprise-class switch with rugged packaging and protected circuitry to meet the needs of the most demanding applications. The switches shall offer the ultimate in port flexibility with 24 fast Ethernet SFP ports for any mix of copper RJ45 or fiber transceivers. The switches shall have universal mounting features, LEDs, power/ground connections, console ports and bracket positions on both the front and back of the switch. This allows the same unit to be conveniently installed in both front and rear/reverse arrangements as needed:

a. IEC 61850/1613 compliance.

b. Enterprise-class networking and security.

c. Port flexibility for field configuration and upgrade.

d. Fiber optic ports for noise-immunity.

e. Universal mounting.

f. Dc power supply to operate off of substation power system.

2.14 Satellite-Synchronized Clock.

The satellite-synchronized clock shall provide high-accuracy time in multiple formats. Self-checking

functions shall be included. Specific requirements are as follows:

a. High Accuracy. IRIG-B demodulated outputs shall be within ±100 nanoseconds (average) and ±500 nanoseconds (maximum) of UTC time. Modulated output and serial port IRIG-B outputs shall be ±1 microsecond of UTC time.

b. Holdover Accuracy. The clock shall have an accuracy of ±0.08 ppm for 20 minutes (over the entire operating temperature range) while the clock is not locked to the GPS satellite reference.

c. Time Outputs. The clock shall have a minimum of one modulated IRIG-B output and six demodulated IRIG-B outputs programmable to IRIG-B, 1 PPS, or 1k PPS. Any of the demodulated time outputs can be programmed for UTC or local time. The clock shall provide IRIG-B connection capability as well as ASCII time output at one serial port. An optional fiber-optic serial port shall also be available.

d. IEEE Extended Control Functions. IRIG-B outputs shall be capable of adding the extended control functions specified by IEEE 1344 and IEEE C37.118.

e. Daylight Time. The clock shall have automatic daylight saving time advance/return with presets for North America and Europe, or custom DST setting capability.

f. Alarm Contact. The alarm contact shall be programmable to include loss-of-satellite lock, loss of power supply, and processor self-test failure. Alternately, the clock shall provide an output pulse per programmable period for testing or time synchronization.

g. Display. Front-panel LEDs shall display UTC or local day and time as well as clock operational status.

h. Settings. Settings shall be accomplished through easily accessible control (DIP) switches.

i. Software. No proprietary software shall be required to communicate with the clock. Standard PC-compatible terminal emulation programs, such as HyperTerminal®, shall be sufficient to establish communication, provide commands and settings, and download data.

j. Computer Clock Setting Software. The clock shall support the capability to provide date and time to a PC or computer via a communications link using accessory software.

k. Security. Password security shall be provided to control clock access. Security features shall include a 12-character password length, requiring old password entry before changing to a new password, never showing the password on communications ports, and providing a lockout for failed password-entry attempts.

l. Wide-Range Power Supply. The clock shall have a power supply with an operating range of 18

to 300 Vdc and 85 to 264 Vac.

m. Operating Temperature. The clock shall have an operating range of –40° to +80°C with rated accuracy.

n. Robust Hardware. The clock shall meet and be tested for EMI, RFI, shock, vibration, and environmental compliance per the IEEE C37.90, IEC 60255, IEC 61000, and IEC 60068 standards.

o. Safety. The clock shall be CE-compliance marked, meeting the IEC 61010 standard, and shall be UL listed and CSA certified. The optional fiber-optic serial port shall be certified to IEC 60825-1 and 21 CFR 1040.10 Class 1 Laser Product compliance.

p. Warranty. The clock shall have a minimum warranty period of 10 years.

2.15 Power Inverter

Provide a 2000 VA, 125 VDC/120 VAC power inverter. The power inverter shall have full electronic protection, high efficiency and low output noise. Specific requirements are as follows:

a. 125 VDC input, inrush current limiting and reverse polarity protection.

b. Pure sine wave 120 VAC 60 Hz output, current limiting with short circuit protection, thermal shutdown with automatic reset in case of insufficient airflow.

c. Full electronic protection (Meets requirements of EN 55022: 1987 Class B conducted emissions).

d. Telecom and power industry quality.

e. Rackmount.

f. Dry contact failure alarm, connected to PMCS.

g. Ruggedization.

h. Conformal Coated.

i. Extended Temperature rated.

2.16 UPS

Provide a 1500 VA pure sine wave uninterruptible power supply, 120V input/output. UPS will utilize

a maintenance-free Lead-Acid battery with suspended electrolyte in a leakproof shell.

UPS will have an LED status display with load and battery bar-graphs and On Line: On Battery: Replace Battery: and Overload Indicators.

PART 3 EXECUTION

3.1 INSTALLATION

The Contractor may start installation after Government acceptance of the Technical Data Packages 1 and 2.

3.1.1 Existing Condition Survey

The Contractor shall connect to and utilize existing devices as shown. The existing legacy SCADA system located at the Main Substation shall be incorporated into the new PMCS and shall have the same functionality as the rest of the system. The Contractor shall perform a field survey, including inspection of all existing devices intended to be incorporated into the system and furnish an existing conditions report to the Government. The report shall identify those items considered nonfunctioning. The Contractor shall provide (with the report) specification sheets, or written functional requirements to support the findings and the estimated cost to correct the deficiency. If a device fails after the Contractor has commenced work on that device, the Contractor shall diagnose the failure and report the failure to the Government. The Contractor shall be held responsible for repair costs due to Contractor negligence or abuse of Government equipment.

3.1.2 Scheduling of Work and Outages

The Contract Clauses shall govern regarding permission for power outages, scheduling of work, coordination with Government personnel, and special working conditions.

3.1.3 Demolition and Removal

N/A

3.1.4 Installation of Field Equipment

3.1.4.1 Installation General Requirements

The Contractor shall install all field equipment as specified and required for a fully functional and operational system. The Contractor shall exercise caution when drilling holes in panels housing energized equipment. When mounting field equipment, the Contractor shall not allow metal shavings to fall into energized equipment. All work related to power equipment, including installation of instrument transformers on high voltage equipment and feeders, shall be as required in Sections 33 71

02.00 10 UNDERGROUND ELECTRICAL DISTRIBUTION SYSTEM,, 33 75 00.00 40 HIGH VOLTAGE SWITCHGEAR and 26 20 00 INTERIOR DISTRIBUTION SYSTEM, 26 11 16 SECONDARY UNIT SUBSTAIONS, 26 23 00 SWITCHBOARDS AND SWITCHGEAR.

3.1.4.2 Grounding

The Contractor shall provide grounding in accordance with manufacturer's recommendations and as specified. The Contractor shall provide an adequate ground for all enclosure circuits and cable shields to prevent ground loops and electrical noise from adversely affecting operation of the system.

3.1.4.3 Communications Equipment

The Contractor shall be responsible for installing and testing communications equipment.

3.1.5 Installation of Workstation Equipment

The Contractor shall install all Workstation and peripheral equipment as specified and shown for an operational system.

3.1.6 Installation of Current Transformers

Each terminal of each current transformer shall be connected to a short circuiting terminal block.

3.1.7 Installation of Software

3.1.7.1 General

The Contractor shall install all software as specified and required for an operational system including databases, operational parameters, LAN, system, command, application, and Workstation programs. Upon successful completion of the Performance Validation Test (PVT), the Contractor shall provide original and backup copies of object modules for all accepted software including diagnostics, on each type of media utilized. The hard drive on each workstation shall be partitioned and formatted at the factory, and all workstation software shall be installed on the hard drive at the factory. The Contractor shall provide one master copy and one back-up copy of all software, including the operating system, on CD-ROM.

3.1.7.2 Development of Database

The Contractor shall develop the entire system database, using data shown, and the Contractor shall supply all other data required for the database.

3.1.7.3 Displays Required

The Contractor shall provide the displays specified and as shown. All real-time inputs for the displays shall be included. All graphics provided shall be in the format and meet the requirements of paragraph USER INTERFACE SOFTWARE.

3.1.8 Installation of LAN Equipment

a. The Contractor shall install all LAN equipment as specified for an operational system.

b. LAN cable shall be prepared in accordance with the cable and connector manufacturer's instructions. Category 5 rated connectors, as defined by TIA/EIA-568-B.1, shall be used for direct connection to the cable. Cables shall be of sufficient length to allow equipment displacement of at least 8 feet in any direction.

3.2 SITE TESTING

3.2.1 General

The Contractor shall provide all personnel, equipment, instrumentation, and supplies necessary to perform all site testing. The Government will witness all PVT testing. Original copies of all data produced, including results of each test procedure, during the PVT shall be turned over to the Government prior to approval of the test.

3.2.2 Factory Acceptance Testing (FAT)

An acceptance test for the PMCS and substation automation is required. The test of the units and components shall be done at the corresponding manufacturing plant prior to the delivery of each substation/switchgear to the construction site. All devices used in the automation system shall be functionally tested during their construction. An acceptance test of the units and cabinets shall be done according to the agreed upon time schedule. Prerequisites for the factory acceptance test are the following:

a. Presentation of complete documentation (circuit manual, unit documentation).

b. All components are fully equipped and previously tested by the manufacturer.

c. All components have been operationally connected for a system test and the required auxiliary powers are applied.

d. System inputs have been emulated for the components to be tested.

e. Inspection protocols with regard to insulation test, impulse voltage test and manufacturers function test have been presented.

f. A competent (professionally and commercially) contact person for the system test is to be named for the manufacturer.

g. The inspection program is to be presented for acceptance prior to the FAT and the entire configuration is to be implemented. The entire software configuration shall be completed before commencing with the FAT.

Execution of the FAT:

a. The manufacturer shall be responsible for the report of the FAT. The basis is the FAT test procedure which has been previously determined by both parties.

b. Detected deficiencies and remarks shall be recorded during FAT meetings. Deficiencies shall be corrected prior to delivery.

c. Signals are to be simulated and their function is to be tested throughout the system. Meters and displays are to be used to show binary quantities and values.

d. Inspection acceptance of the FAT shall be done in writing.

3.2.3 Site Acceptance Testing (SAT)

a. The automation system shall undergo Site Acceptance Testing (SAT), upon completion of the commissioning of each substation/switchgear. The acceptance of the entire inspected automation system shall depend upon meeting the criteria outlined herein. SAT shall include testing units, cabinets and functions in accordance with the specifications and drawings

b. All test and inspection papers shall be handed to the owner. The SAT shall commence once the owner’s approval.

3.2.4 PVT

The Contractor shall demonstrate compliance of the completed system with the contract documents. Using approved test procedures, all physical and functional requirements of the project shall be demonstrated and shown. The PVT as specified shall not be started until after receipt by the Contractor of written permission by the Government, based on the Contractor's written report including certification of successful completion of Contractor's Field Testing as specified, and upon successful completion of training as specified. The PVT shall be performed as an integrated test with the data transmission system, and with all equipment specified operating and exchanging actual data under fully loaded conditions.

3.3 TRAINING

3.3.1 General

The Contractor shall conduct training courses for designated personnel in the maintenance and operation of the system as specified. The training shall be oriented to the specific system being installed under this contract. Training manuals shall be delivered for each trainee with two additional copies and in electronic format delivered for archival at the project site. The Contractor shall furnish all audiovisual equipment and all other training materials and supplies. Where the Contractor presents portions of the course material by audiovisuals, copies of those audiovisuals shall be delivered to the Government either as a part of the printed training manuals or on the same media as that used during the training sessions. A training day is defined as eight hours of classroom instruction, including two 15-minute breaks and excluding lunchtime, Monday through Friday, during the daytime shift in effect at the training facility. For guidance in planning the required instruction, the Contractor shall assume that attendees have a high school education or equivalent, and are familiar with utility systems. Approval of the planned training schedule shall be obtained from the Government at least 30 days prior to the training.

3.3.2 Operator's Training I

The first course shall be taught at the project site for a period of two consecutive training days during or after the Contractor's field testing, but before commencing the PVT. A maximum of 15 personnel will attend the course. No part of the training given during this course shall be counted toward completion of the PVT. The course shall include instruction on the specific hardware configuration of the installed system and specific instructions for operating the installed system. Upon completion of this course, each student shall be able to start the system, operate the system, recover the system after a failure, and describe the specific hardware architecture and operation of the system. This course shall include:

a. System architecture.

b. Functional operation of the system.

c. User commands.

d. Display generation.

e. Database entry.

f. Reports generation.

g. Diagnostics.

h. LAN operation, if required.

3.3.3 Operator's Training II

The second course shall be taught at the project site for a period of one training day approximately one month after completion of the PVT. The Government will determine the specific date of the training session. A maximum of 15 personnel shall attend the course. The course shall be structured to address specific topics that the students need to discuss and to answer questions concerning the operation of the system. Upon completion of the course, the students should have no unanswered questions regarding operation of the installed system.

3.3.4 Maintenance Training

The maintenance course shall be taught at the project site within thirty days after completion of the PVT for a period of two training days. A maximum of 15 personnel will attend the course. The training shall include:

a. Physical layout of each piece of hardware.

b. Troubleshooting and diagnostics procedures.

c. Repair instructions.

d. Preventive maintenance procedures and schedules.

e. Calibration procedures.

-- End of Section --